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Layout Design and Its Effects on Burglary

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Abstract

This paper presents preliminary findings of an ongoing research in attempts to answer if residential layouts in Malaysia influence similar burglary distribution patterns as in a previous syntax-based study. The instrument used in this research was space syntax, a tool to analyze urban spaces. By comparing burglary rates to syntactical spatial attributes in eight residential layouts, the findings of this paper showed how spatial attributes influenced burglary. It also attempted to relate how degree of permeability of layouts may have affected vulnerability. It concluded by suggesting for further studies to look into spatial factors that could interact together to influence burglary.

Keywords: Space syntax; permeability; residential layout; burglary

1. Introduction

Studies linking crime to the environment started as far back as the 1920s when the Chicago School led by Shaw and McKay studied juvenile delinquency. Nevertheless, it was the later works that have been more influential for example, Jacobs (1961) on how different kinds of city streets influenced the level of safety differently, in which the more movement of people and vehicles on the streets the less the crime, and another albeit contradictory, those of Newman (1972), who suggested that the lesser movement on the streets where residents are in control of their surroundings are safer. Hillier and Shu (2001) in a study linking burglary to urban space seems to support Jacobs' findings. Their study (Hillier and Shu) as well as

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Hillier and Sahbaz (2008), not only showed how crime were influenced by the configuration of the spaces but rather it can be examined at a much finer scale so as to produce more precise results.

Nonetheless, the understanding of what constitutes a city should be seen as an essential starting point in studies linking crime to the environment. This was clearly illustrated in studies like those by Shu (2001), Hillier and Shu (2002), and Hillier and Sahbaz (2007, 2008). In these studies, both the areas and the streets within the areas were examined to explain the patterns and distribution of crime.

How do cities and streets relate? A city can be seen as a system of spaces created by the physical stuff, which is the buildings. Although buildings create or modify spaces and the interconnections, space is the universal stuff that holds the physical stuff together and gives it its overall form (Hillier 1998). Stonor (2008) explains this relationship as “cities are large collections of buildings held together by a network of space: the street network.” He further adds that, “Space has an architecture, that is a certain geometry and a certain topology that is a certain pattern of connections.” It is with this understanding that this paper explores layout in residential areas and its relationship to burglary, i.e. how that certain geometry or that certain pattern of connections in layouts influenced burglary. The next section of this paper looks at this pattern of connections, which relates to permeability of a layout.

2. Permeability of layouts

Permeability is the degree to which an area has a choice of routes through it (Cowan, 2005). Cowan noted that “a variety of convenient and safe routes (as opposed to layouts in big blocks with no way through) is thought to make a place better suited to people on foot”. Nevertheless, Cowan said some people, like the police, see permeability as undesirable especially if it is a housing layout with a high degree of permeability because it is thought to provide a choice of escape routes for criminals.

In a previous syntax-based study on crime and space in residential areas, it has shown that the more permeable layout is generally safer than the less permeable layout. It also showed that a highly permeable layout is highly vulnerable to crime. Although it seems to implicate that a more permeable layout with better access and allows easy movement is safer than a less permeable or non-permeable layout that restricts movement potentials, over-permeability can spell danger. Thus, if it is safer living in a more permeable layout, how permeable should it be? What is the ‘right degree of permeability’ that could ensure safety in a layout, if there is one?

How can permeability be measured? Many have illustrated that permeability can be measured by determining the size of blocks. In a study by Space Syntax Limited on Croydon Town Centre in the UK in 2008, it suggested that if an area is mainly composed of small blocks it indicates that the layout is very permeable, and if it is mainly of large blocks, than it is less permeable as illustrated in Fig. 1 and 2. A layout becomes impermeable if it is a large single block (Fig. 1 on the right) compared to a layout with several blocks (figure left). But, a layout with several blocks can affect its degree of permeability, from very permeable to moderate or less permeable. As shown in Fig. 2, the square grid with small blocks is more permeable compared to the oblong grids with coarser blocks (diagram in the centre and on the right). Thus, it implicates that the degree of permeability of an area is directly related to the size and layout of blocks within it. An area with many small blocks or fine urban grain is assumed to provide many different options of movement within an area as compared to one with a coarse urban grain.

Fig. 1. A block with through streets and is well connected is permeable (left) compared to a block with cul-de-sacs that does not allow through traffic (right). Source: http://yourdevelopment.org/

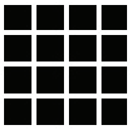
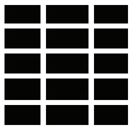
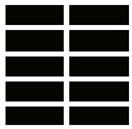
	 **Square grid** (Miletus, Houston, Portland, etc.)	 **Oblong grid** (most cities with a grid)	 **Oblong grid 2** (some cities or in certain areas)
Percentage of area for streets	36.0%	35.0%	31.4%
Percentage of buildable area	64.0%	65.0%	68.6%

Fig. 2. The level of permeability is higher in a square grid compared to an oblong grid. Source: Southworth, (1997).

Similarly, Bentley et al. (1985) also suggested that not only does a place have to allow easy movement through it and to get to other locations it should also be integrated physically or connected to its surrounding areas. One of the ways this could be done is by providing maximum choice of how people will make their journey (Bentley et al. 1985). They cited an example of an existing shopping centre in Oxford that could be redesigned to increase its permeability. The shopping centre, which consists of 5 blocks with 5 entries and 3 internal choices, can be more permeable by reducing the size of blocks to become 8, which in turn will allow 9 entries into the area with 5 internal choices for people to make their journey. Thus, the entry to the area can be increased by reducing the size of blocks. This suggests that the number of entry into an area can reflect the degree of permeability, the more entries into the area the more permeable is the area.

Fig. 3. Bentley et al. suggested for a more permeable layout of the shopping centre (right) that would allow more choices for people to make, which also could improve the quality of its urban design. Source: Bentley *et. al* (1985).

Nonetheless, permeability can be distinguished between visual and physical permeability. While 'visual' permeability refers to the ability to see the routes through an environment, 'physical' permeability refers to the ability to move through an environment (Carmona et al., 2003). Thus, Carmona et al. suggested that an area can be visually permeable but it is not necessarily permeable physically. They further added that in terms of physical permeability the shape of a grid does not really matter, but irregularities in a grid or a deformed grid affects visual permeability and as a result, affects potential movement. This may seem to implicate that the more deformed a grid, the bigger the block sizes and the less visually permeable it becomes, and this can be taken as having a lower degree of physical permeability.

This paper further questions what features of permeable layout can either increase or reduce vulnerability. Are areas with mainly smaller blocks that ease movement safer than bigger blocks? In attempting to answer these questions, eight areas were selected randomly within a town in the Petaling District. These areas are of varying degrees of grid-like layouts, from the very grid with mainly linear through streets to the fewer grids with some cul-de-sacs.

3. Research aim

This study investigates the effect of layout on the spatial pattern of burglary. Desyllas (1999) in Kim and Sohn (2002) defined urban layout as the morphology of the street network – thus the configuration of streets and public spaces. According to the Space Syntax theory, an urban space layout is a system of lines and convex spaces and how they interrelate. This paper presents initial findings of an ongoing study on the relationship between burglary and urban spaces.

4. Methodology

The study used space syntax to analyze the spaces in the case study areas. Space syntax is a set of techniques for representing and analysing street networks of cities in such a way as to bring to light underlying patterns and structures which influence patterns of activity in space, most notably movement and land use (Hillier and Sahbaz, 2008). Before the case study areas can be analysed, an axial map (a space syntax line map) was first produced (Fig. 4).

Next, three years' burglary data (2006-2008) provided by the Malaysian Royal Police Force (PDRM) was mapped as dots onto the axial map. In complying with the confidentiality of this data, the study areas have been anonymised and named as Sub Areas A, B, C, D, E, F, G and H. By mapping the burglaries, the spatial characteristics and attributes of the spaces in which burglaries occurred can be explained at two levels: first, between sub areas, and, second, within each line (streets). The burglary rate was calculated by finding the ratio of houses per burglary for each sub area.

The next stage of the study was to determine the degree of permeability of each sub area. This was done by simply calculating the number of entries into each sub area, as well as determining the proportion of various block sizes within each sub area. The sizes of the blocks were measured and categorised into: fine blocks (200-8000 square meters), moderate blocks (8000-32000 square meters), coarse blocks (32000-64000 square meters) and very coarse blocks (>64000 square meters). Table1 shows the study areas are made up of blocks ranging from fine to blocks (check–vague). When the number of entries are calculated, only 1 area (Sub Area G) with 73% moderate blocks has a high degree of permeability, and 2 areas (Sub Areas E and F) with more than 67% and 75% coarse to very coarse blocks respectively, with a very low degree of permeability. Although Sub Areas with mainly coarse blocks (e.g. Sub Areas D, E, and F) appear to correspond to a lower degree of permeability, areas comprising mainly moderate size blocks do not (e.g. Sub areas A and G). Thus, block sizes of the study areas appeared to be not related directly to the degree of permeability.

Burglary rates between sub areas were then compared to the number of entries to determine if there is a relationship between the degree of permeability and burglary. The total number of burglaries combined was 53 over a 3-year period distributed amongst 3899 houses or an average rate of 1 in 74 houses. This rate is further broken down by Sub Areas as shown in Table 1 and compared to the degree of permeability for each area. Following this, the study attempted to compare within the vulnerable spaces, the degree of integration, connectivity, intelligibility, and synergy and how these spatial attributes relate to vulnerability.

Table 1. Burglary rates compared with degree of permeability in Sub Areas

Sub Areas	Burglary	No. of entries	200-8000 sq m	8000-32000 sq m	32000-64000 sq m	> 64000 sq m	Degree of permeability
Sub area A	1 in 84 houses	12	8.08	91.92	0	0	Moderate
Sub area B	1 in 72 houses	9	21.24	41.78	36.98	0	Moderate
Sub area C	1 in 46 houses	11	3.55	33.81	0	62.64	Moderate
Sub area D	1 in 53 houses	8	3.63	25.51	37.92	32.94	Low
Sub area E	1 in 142 houses	4	15.07	17.46	32.56	34.91	Very low
Sub area F	1 in 155 houses	2	3.31	21.41	26.03	49.25	Very low
Sub area G	1 in 90 houses	20	12.2	72.58	15.22	0	Very high
Sub area H	1 in 416 houses	7	17.76	32.54	0	49.7	Low

5. Results and discussions

5.1. Permeability and burglary rate

Although Table 1 seems to indicate that areas benefit when they have very low to low degree of permeability, it does not reflect if there is any effect for areas with moderate to high or very high degree of permeability on burglary rate. If the proportion of block sizes is compared across sub areas, it can be found that the area with mainly very coarse block (> 64000 square meters) is highly vulnerable to burglary (Sub area C). When the block sizes are divided into 2 categories, finer blocks (sizes between 200 – 8000 square meters) and coarser blocks (more than 8000 square meters), the second category of blocks is highly vulnerable to burglary. It seems to implicate that we are safer staying within the smaller (fine) blocks than within the larger or coarse blocks. Generally, most of the houses in the finer block sizes are terraced and the coarser, semi-detached and detached houses.

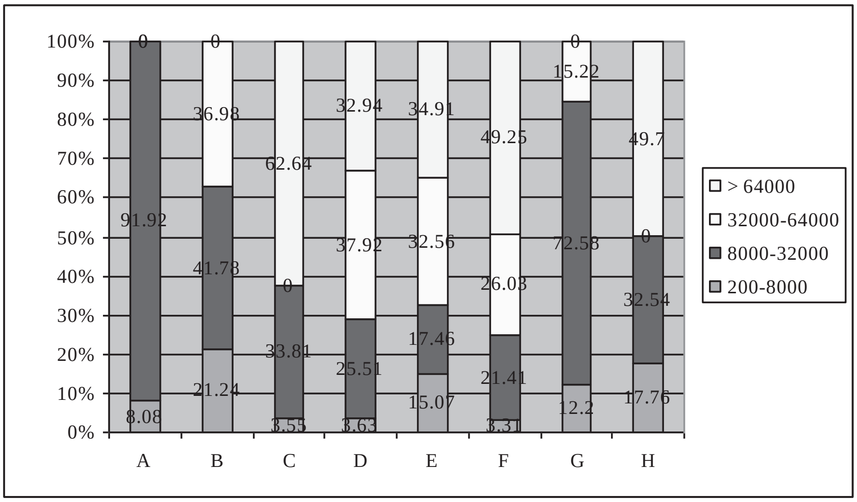


Fig. 4. Proportion of blocks within sub areas

5.2. Influence of spatial characteristics on burglary rate

The axial map of the study area when processed at radius 3 (Fig. 5) displayed a range of colours from the darkest lines (the more integrated spaces) through to the lighter lines (the less integrated spaces). The lines representing streets are more integrated (with more movements of vehicles and pedestrians) to the north of the darkest line and lighter (less integrated) to the South. The spatial measures: radius n (global integration), local integration (radius 3 and radius 10), connectivity, intelligibility (the correlation of local and global syntactical properties), and synergy (the degree of relationship to which connectivity and radius 3 correlates) of the sub areas are tabulated (Table 2) and compared with the burglary rates.

Although it looks like the area (sub area H) that is the most integrated globally (0.95) and locally (1.33), is also highly intelligible (0.39) and very high in synergy (0.60) is the safest (1 burglary in 416 houses), the burglary rates in other sub areas do not reflect similar explanations.

Fig. 5. Axial Map processed at radius 3 (local integration)

Table 2. Burglary rates compared to syntactical spatial measures

Sub areas	Burglary rate	Radius n	Radius 3	Radius 10	Connectivity	Intelligibility	Synergy
A	1 in 84	0.88	2.6	1.32	4.73	0.11	0.24
B	1 in 72	0.87	2.61	1.31	4.8	0.32	0.52
C	1 in 46	0.87	2.47	1.23	4.73	0.41	0.52
D	1 in 53	0.91	2.48	1.29	4.54	0.49	0.52
E	1 in 142	0.91	2.59	1.29	4.95	0.32	0.50
F	1 in 155	0.75	2.05	1.11	3.57	0.25	0.32
G	1 in 90	0.92	2.52	1.31	4.48	0.24	0.48
H	1 in 416	0.95	2.23	1.33	4	0.39	0.60

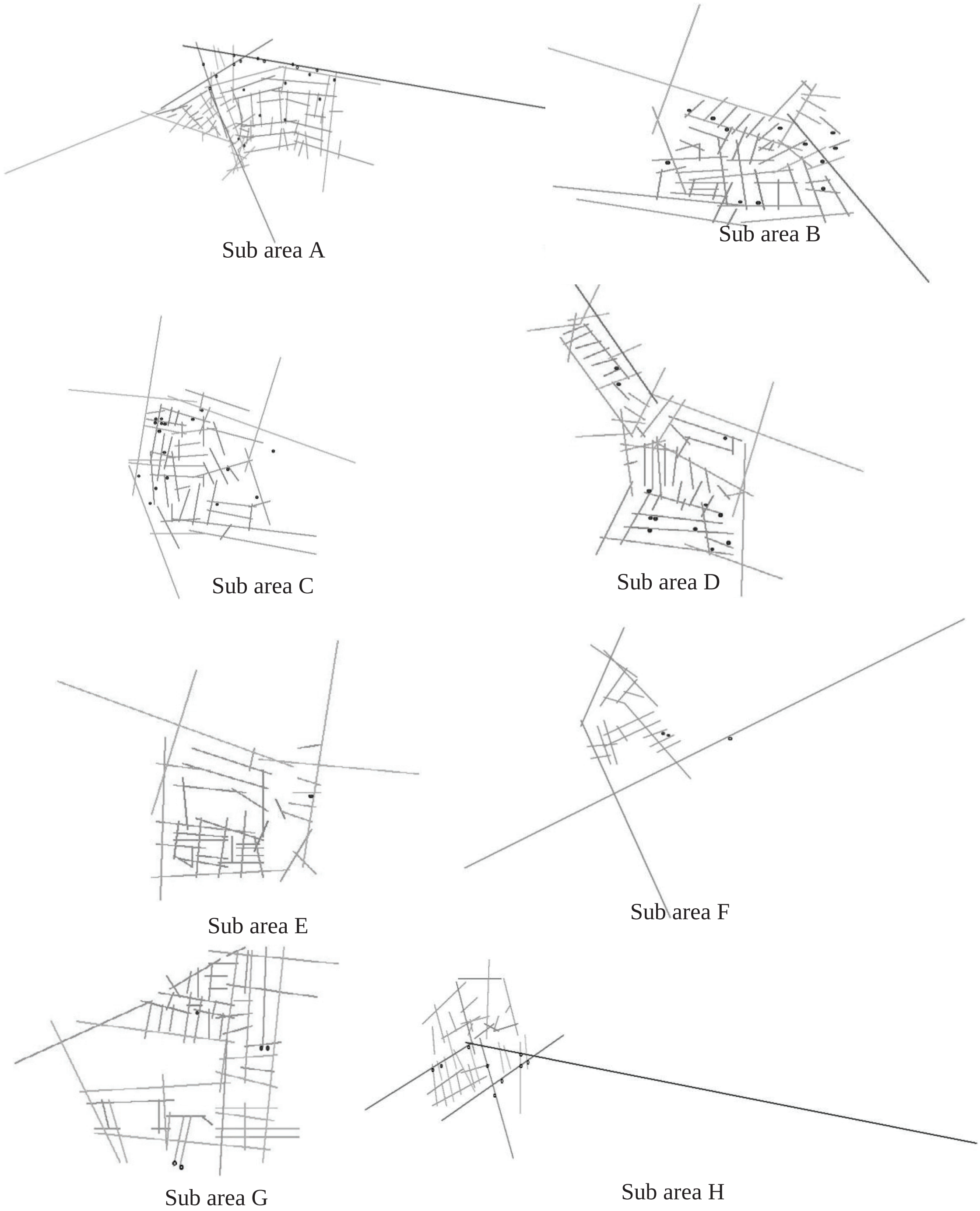


Fig. 6. Axial maps of eight sub areas in which burglary has been mapped as dots

Next the study looked at the spatial characteristics of all the lines (the spaces). There are 44 lines in total, in which the burgled houses are located. When compared with radius n (global integration), the results showed 52% of the lines, on which the houses are located are less globally integrated (Fig. 7). A similar result was also indicated when compared to the local integration (radius 3), where 50% of the houses were located on the more locally integrated lines and another 50% on the less integrated locally (Fig. 8). However, when the lines are compared to local integration (radius 10), the study found that only 36% of the lines are less integrated (Fig. 9). Although the previous syntax-based study suggested that areas that are more integrated are safer, this study found that houses in integrated spaces can also be vulnerable to burglary.

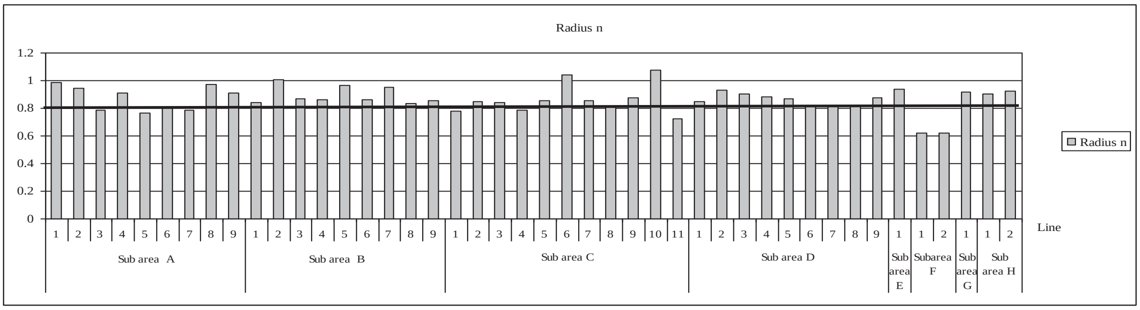


Fig. 7. Comparison between global integration (radius n) and burglary rate between Sub Areas

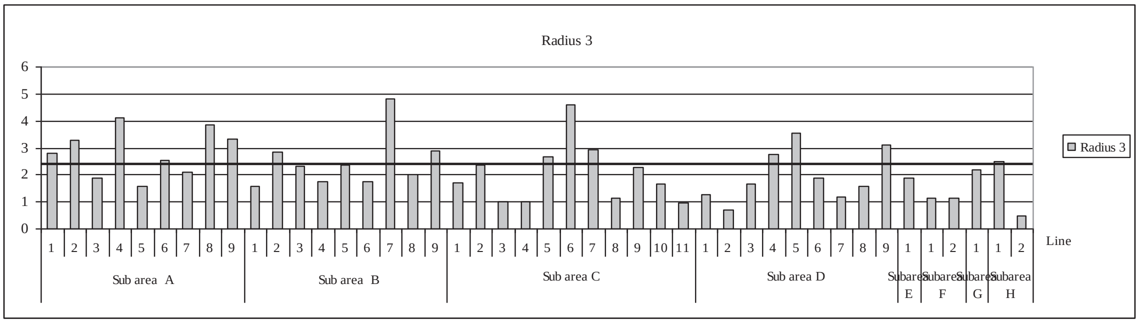


Fig. 8. Comparison between local integration (radius 3) and burglary rate between Sub Areas

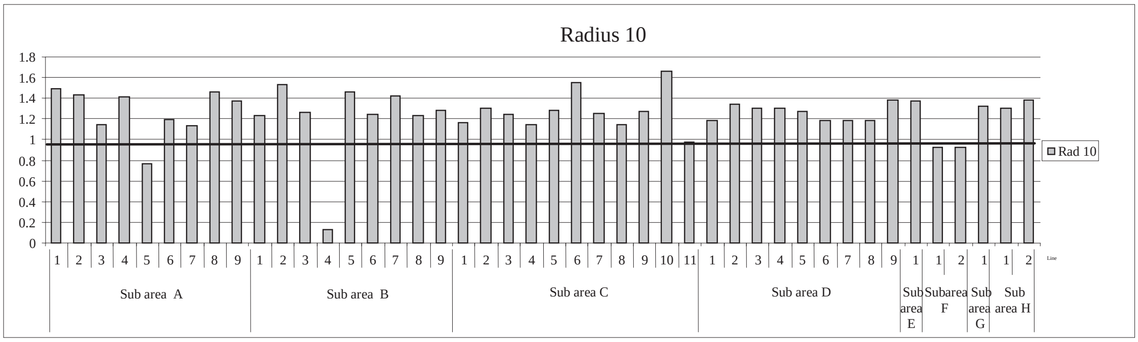


Fig. 9. Comparison between radius 10 and burglary rate between Sub Areas

This study also analysed if the lines in which burglaries happened are related. Interestingly it found that 84% of the lines in which burglaries occurred have less than 7 connections to other lines (Fig. 10). This finding appears to be in agreement with the previous syntax-based study, where it was suggested that lines with more connections to other lines are safer than lines with fewer connections.

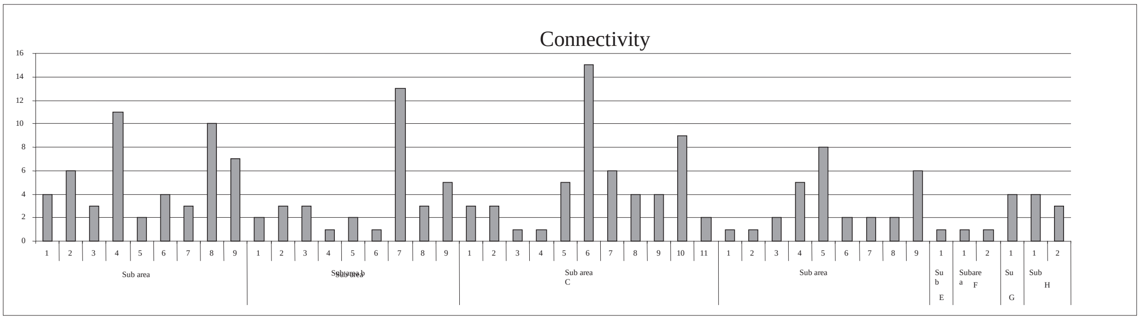


Fig. 10. Comparison between connectivity and burglary rate between Sub Areas

How does the degree of intelligibility and synergy relate to burglary rate? Is it safer living in an area with a high degree of intelligibility and synergy? In answering these questions, burglary rates are compared to intelligibility and synergy measures of the sub areas. Out of 8 areas, 3 (sub areas A, F and G) are low in its intelligibility; and only 2 areas (sub areas A, and F) have low synergy values. The study showed that two areas with high burglary rates (sub areas C and D) are also high in its intelligibility values; whereas areas with lower values are those with moderate or lower burglary rates. Although a layout appeared to benefit having high synergy value (as in sub area H), where there is high natural co-presence of residents and non-residents in the area, it is also shown that layouts with a lower synergy value e.g. sub area F may also benefit.

If the degree of permeability is compared to these values, an area (e.g. sub area G) which has the highest degree of permeability, it may not be highly intelligible but with high synergy levels, it could help to reduce its vulnerability. Similarly, an area with very low permeability e.g. sub area E, can still benefit if its level of synergy is high with a moderate degree of intelligibility. However, areas can also be highly vulnerable (e.g. sub areas C and D) with a moderate and low degree of permeability respectively, even though its degree of intelligibility and synergy is high.

6. Conclusion

Although studies have shown that environment or urban layouts can influence crime, it is essential to examine further what factors in the layout increase its vulnerability. This study has attempted to identify these factors by looking at spatial factors of areas with varying layouts. No doubt it is an ongoing study, its initial findings have to a certain extent indicated that spatial factors do have an effect on vulnerability to burglary. By using space syntax as a tool and a method to understand and analyse the residential spaces, it can be seen as an important starting point that allows future studies on crime and space to be pursued within this region.

Following findings of this paper, this study proceeds to examine what other factors that could have affected burglary patterns in residential layouts. To ensure a more conclusive result, the future study would be looking at layouts with a more homogenous character. It is hoped that by doing so, findings of the study can be both helpful and useful in developing a better Malaysian design guidelines that take into consideration safety and vulnerability.

Acknowledgement

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